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The Director

of the United States Patent and Trademark Office has received an application for a patent for a new and useful invention. The title and description of the invention are enclosed. The requirements of law have been complied with, and it has been determined that a patent on the invention shall be granted under the law.

Therefore, this United States

Patent

grants to the person(s) having title to this patent the right to exclude others from making, using, offering for sale, or selling the invention throughout the United States of America or importing the invention into the United States of America, and if the invention is a process, of the right to exclude others from using, offering for sale or selling throughout the United States of America, products made by that process, for the term set forth in 35 U.S.C. 154(a)(2) or (c)(1), subject to the payment of maintenance fees as provided by 35 U.S.C. 41(b). See the Maintenance Fee Notice on the inside of the cover.

Ander Lane
DIRECTOR OF THE UNITED STATES PATENT AND TRADEMARK OFFICE



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(12) **United States Patent**
Ortega et al.

(10) **Patent No.:** **US 9,717,916 B2**
(45) **Date of Patent:** ***Aug. 1, 2017**

(54) **SYSTEM FOR DETERMINATION AND UTILIZATION OF CARDIAC ELECTRICAL ASYNCHRONY DATA**

(58) **Field of Classification Search**
None
See application file for complete search history.

(71) Applicant: **XSynchro, Inc.**, Bradenton, FL (US)

(56) **References Cited**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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This patent is subject to a terminal disclaimer.

OTHER PUBLICATIONS

Porciani et al., "Utility of a New Left Ventricular Asynchrony Index as a Predictor of Reverse Remodelling After Cardiac Resynchronization Therapy." (Jan. 2006).

(21) Appl. No.: **15/213,254**

Primary Examiner — Brian T Gedeon

(22) Filed: **Jul. 18, 2016**

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(65) **Prior Publication Data**

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(57) **ABSTRACT**

Related U.S. Application Data

(63) Continuation of application No. 14/433,372, filed as application No. PCT/US2013/063130 on Oct. 2, 2013, now Pat. No. 9,392,949.

(Continued)

One embodiment provides a system for determination and utilization of cardiac electrical asynchrony data. The system includes an analysis circuitry including a processor and a memory, the analysis circuitry configured to: obtain a plurality of sets of cardiac signals collected in at least two locations of a heart of a patient, the signals comprising at least one of surface electrocardiography signals and pseudo-surface ECG signals; detect one or more QRS complexes for each of the sets based on the cardiac signals for that set; obtain one or more cross-correlation signals, each of the cross-correlation signals being between at least two of the signal sets and being obtained using the detected QRS complexes from the signal sets; and calculate one or more asynchrony indices using one or more of the cross-correlation signals, each of the asynchrony indices being indicative of a level of asynchrony between the at least two locations.

(51) **Int. Cl.**
A61B 5/04 (2006.01)
A61N 1/365 (2006.01)

(Continued)

(52) **U.S. Cl.**
CPC **A61N 1/3682** (2013.01); **A61B 5/042** (2013.01); **A61B 5/04011** (2013.01);
(Continued)

20 Claims, 33 Drawing Sheets

Multilead Approach – Signal Preprocessing

